SD
395
.S64
No.
SO-ITF-SM-9

Khaya nyasica Stapf. ex Baker f. East African Mahogany

Meliaceae Mahogany family

John K. Francis and Albert Bokkestijn

U.S. Forest Service
Pacific Southwest Library and Information Center
1323 Club Drive
Vallejo, CA 94592-1110

HABITAT

Native Range

Khaya nyasica, east African mahogany, is native to the evergreen high forests and the riverine ecotone forests of Zimbabwe, Mozambique, Zambia, Malawi, Tanzania, and Zaire (*4, 5, 7, 14,* fig. 1). The species is also frequently found in riparian forests (*8*). East African mahogany has been grown successfully in Puerto Rico (*9*), Cuba (*2*), and South Africa (*5*), which are outside the natural range of the species.

Climate

East African mahogany occurs in the tropical summer rainfall zone (*21*), which has well-defined seasons of heavy rains in the summer and severe drought during the cooler winter season. With increasing distance from the equator, the dry season becomes longer and the amount of rainfall decreases correspondingly. The annual precipitation varies from 600 to 1600 mm (*13*).

Soils and Topography

East African mahogany grows best on moist, well-drained, deep alluvial soils (*6*). Soils of the riparian habitat are quite variable in texture (*8*), pH, base saturation, and other properties. East African mahogany prefers stable, gently sloping riverbanks in riparian forests (*14*) and also grows on the adjacent coluvial slopes at the margins of the flood plains (*8*).

Associated Forest Cover

In the riparian forests of Zambia, east African mahogany shares the dominant canopy position with *Diospyros mespiliformis, Parinari excelsa,* and *Syzgium cordatum (8).* In Zaire, it grows in well developed gallery forests with *Chrysophyllum* sp., *Albizia* sp., *Parkia* sp., *Syzygium cordatum,* and *Phoenix reclinata (14).* The riverine forests of Malawi support *Parkia filicoidea, Syzygium cordatum,* and *Adina microcephala* as well as east African mahogany (*12*).

John K. Francis is research forester, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry, Rio Piedras, PR, in cooperation with the University of Puerto Rico, Rio Piedras, PR. Albert Bokkestijn is graduate student, Department of Forestry, Agricultural University, Wageningen, The Netherlands.

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—The flower of east African mahogany is small, white, and sweet scented (*7, 15*). A many-flowered raceme or panicle develops at the end of the dry season or beginning of the rainy season, mainly during November. Fruit from the previous year's flowers ripen during the spring or early part of the summer. The fruit is a globose, four-valved capsule up to 8 cm in diameter. Each fruit contains a number of flat, waferlike seeds with a reddish-brown color.

Seed Production and Dessemination.—The seeds are winged and are carried in a spiral motion on the air for a short distance out from the mother tree. Seed collected in Puerto Rico yielded 3,086 air-dry seeds per kg, an average of 26 seeds per capsule. Seeds produced by local trees have been the basis for limited plantations in Puerto Rico and Cuba. Natural reproduction is present in two locations. In the native range, east African mahogany produces seed irregularly (*6*).

Seedling Development.—Seedlings can be started from seeds, and germination normally takes about 3 weeks (*15*). Seeds should be sown fresh, as the ability of *Khaya* seeds to germinate is lost fairly quickly (*1*). In the northern Transvaal of South Africa, best results were obtained when seeds were

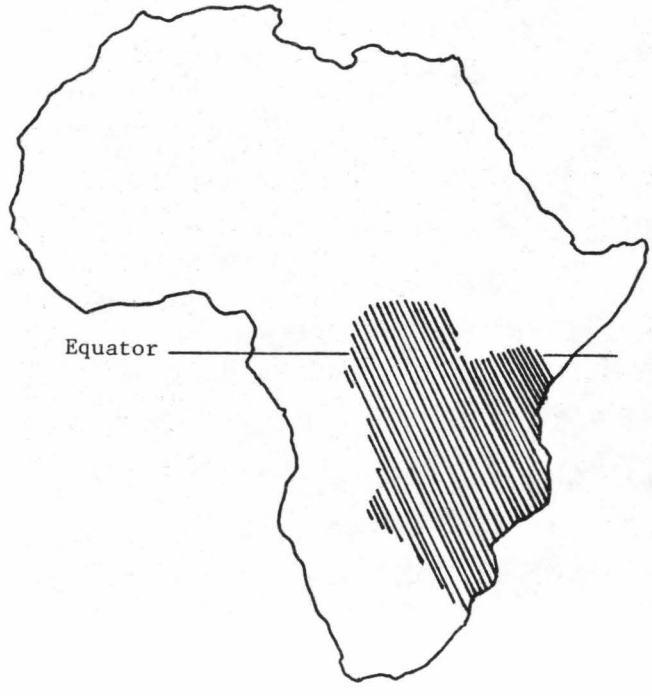

Figure 1.—*Distribution of* Khaya nyasica *in Africa.*

sown during the spring or early summer in lightly shaded beds of semidecomposed pine bark mixed with compost. Seedlings need light shade and a permanently moist potting medium. The seedlings were transplanted into large polyethylene nursery bags when 5 cm tall and out-planted at 1 year. Seeding directly into plastic bags filled with a mixture of compost, pine bark, and sandy soil has also been done, but lower germination resulted. When grown in small containers, seedlings are outplanted when they reach 30 cm and have fully developed compound leaves (*6*). Planting should begin at the second soaking rain of the wet season and may take place from October to April in the Transvaal, but early summer is preferred.

Under normal conditions, about 1,000 plants can be obtained from a kilogram of seed. Some seedlings will form a crooked stem during germination. These seedlings are normally culled. East African mahogany has been planted in South Africa at 5- by 5-m spacings (*6*). A small plantation (49 trees) in the Luquillo Mountains of Puerto Rico was spaced at 2.4 by 2.4 m. There was still 100-percent survival at 24 years, but the trees needed to be thinned.

Vegetative Reproduction.—East African mahogany will coppice (*5*) if it is not too old when cut.

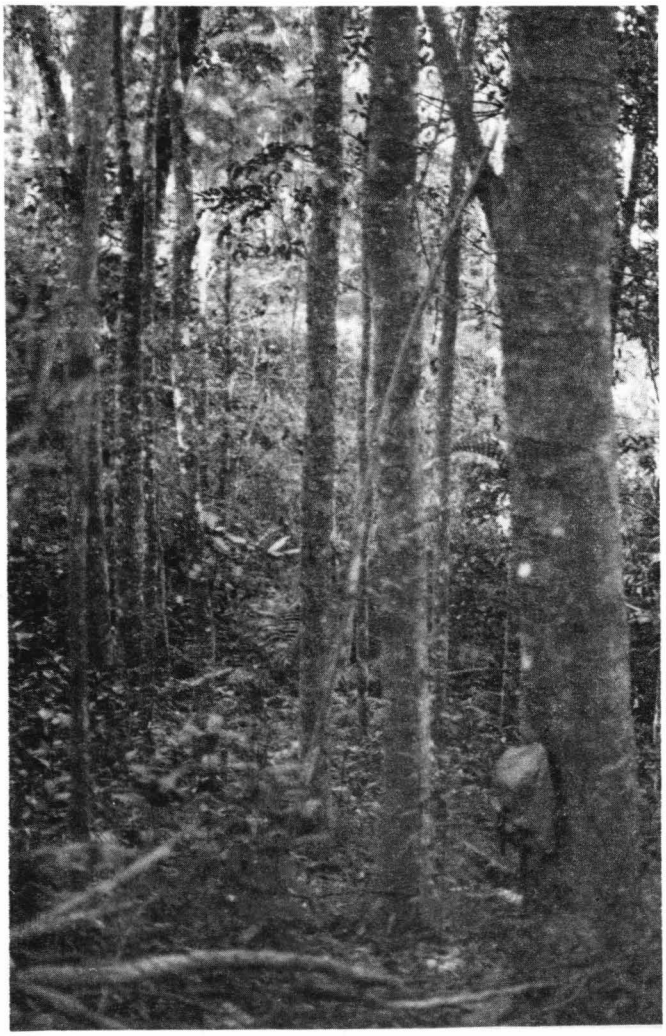

Figure 2.— *East African mahogany, 26 years old, growing in Puerto Rico.*

Sapling and Pole Stage to Maturity

Growth and Yield.—The Raul model of tree growth fits this red mahogany. This model describes a monopodial trunk that grows rythmically, developing tiers of branches (*11*). The monopodial trunk may extend to heights of 10 m or more. The stem is straight and cylindrical with a small buttress, and the crown is rounded and much branched (*6*).

The largest reported east African mahogany was 61 m tall and had a diameter at breast height (d.b.h.) of 5 m (*15*). The typical east African mahogany, however, is about 18 m tall (*7*), or according to another source (*20*), 30 m tall with a 15 to 20 m clear bole and a d.b.h. of 1.0 to 1.5 m. This probably represents differences in site conditions across the range of the species.

Five trees sampled in South Africa at an elevation of 1,000 m, with a mean annual rainfall of 1,250 mm on a deep clay loam soil, had a mean height of 20 m and a d.b.h. of 54.5 cm at 27 years. On a similar site nearby, trees on a 16-year-old plot had total heights of 13.7 to 15.2 m, d.b.h.'s of 29 cm, and good form (*16*). In eastern Zimbabwe, a 4-year-old plantation had heights ranging from 4.1 to 4.8 m with d.b.h.'s of 4.8 to 6.6 cm (*16*). A 50-year-old plot, which had never been thinned, has 1136 stems/ha, a basal area of 43 m^2/ha, an average height of 31 m, and a d.b.h. of 22 cm. The mean annual volume increment over the 50 years was 13.6 m^3/ha. Twelve years later, the basal area had increased to 59 m^2/ha, but many trees were beginning to die. In South Africa, rotations are projected for 30 to 40 years (*5*).

On eight adaptability trial plots in Puerto Rico, after a first year average height growth of only 0.4 m, height increment increased to a little less than a meter per year for the next 4 or 5 years. At 25 to 26 years, plot average heights ranged from 8 to 17 m and d.b.h's ranged from 15 to 36 cm (fig. 2). The largest individual east African mahogany in Puerto Rico, located on the University of Puerto Rico campus in Rio Piedras, is 55 years old and measures 32 m tall and 107 cm d.b.h.

Rooting Habit.—Little is known of the east African mahogany's rooting habit.

Reaction to Competition.—In the seedling and sapling stage, east African mahogany is sensitive to competition from weeds, grass, and brush. To successfully establish the species, periodic hoeing and cleaning is necessary after planting (*6*). The species is classified as moderately shade tolerant when young and moderately intolerant as a mature tree. A small, unthinned 26-year-old plantation (49 trees) in Puerto Rico has not stagnated even though overstocked, but has been slow in differentiating into crown classes. Larger border trees indicate potential benefits that might have been obtained by early thinning. Selective pruning is conducted in South Africa once saplings are out of reach of browsing animals (*6*). Pruning is concentrated on forks, and double leaders to improve form.

The strategy for survival of this species seems to be steady growth and long life that eventually results in dominance in the forest canopy, for only as a dominant can east African mahogany produce seeds in quantity. Of the many seeds produced, a few manage to germinate and survive in favorable positions where there is filtered sunlight and relatively low competition. The recruitment of new east African mahogany into the overstory involves gaps formed in the canopy by the death or destruction of individuals or groups of dominant trees. The result is that east African mahogany typically occurs in the primary forest as common, but disbursed, large dominant trees (*10*).

If advanced regeneration exists on the ground, clearcutting in several stages would probably result in a new stand with a component of east African mahogany. If no regeneration is found under the stand, a shelterwood harvest would be a logical approach. However, planting is a quicker, more likely way to ensure regeneration of this species.

Damaging Agents.—East African mahogany is very sensitive to fire and frost (*7*). Browsing animals can destroy or arrest the growth of plantations or reproduction; rodents also cause considerable seedling damage if not controlled (*6*). All African mahoganies are attacked by the mahogany shootborer, *Hypsiphyla robusta* (*9*), which causes forking and reduced growth, but are apparently resistant to the mahogany borer, *H. grandella*, of the New World (*3*). East African mahogany has been attacked by the shoot and twig borer, *Mussidia nigridenella* in South African plantations (*6*). Bark cankers and gumosis frequently seen on planted east African mahogany in Cuba have been associated with the bacteria *Xanthomonas* spp., *Corynobacterium* sp., and the fungi *Tubercularia* sp. (*2*). It has been reported that the sapwood of east African mahogany may be attacked by borers and that termites will eat even the heartwood if it is left exposed to them (*10*). However, another source describes the species as being "untouched by borers and termites" (*7*). The sapwood is susceptible to attack by powderpost beetles, *Lyctus* spp. (*3*). East African mahogany wood weathers well aboveground but it is not resistant to rot when in contact with the ground (*7*).

SPECIAL USES

East African mahogany wood is pinkish red when first cut, but changes on exposure to a dark red (*15*). Drier sites produce a lighter colored wood (*4, 18*). The wood seasons easily and air dries to 500 to 650 kg/m^3, depending on where it was grown (*15, 18*). Shrinkage when progressing from green to air-dry wood is 1.6 percent radially and 3.6 percent tangentially (*18*). The wood saws and machines easily with good equipment (*3*). There is a tendency to wooliness if cross grain is encountered during planning and machining (*15*). The sapwood is moderately resistant and the heartwood extremely resistant to impregnation (*20*). East African mahogany is a popular wood for furniture and cabinet making, and is also used for framing, paneling, and veneer (*7*). Large quantities have been shipped, especially to Europe. The large logs of this species are used by natives in east Africa to make dugout canoes (*15*). East African mahogany is also used as a shade tree and for fuelwood. Bark infusions containing a bitter substance are drunk by natives to treat colds, and an oil from the seeds is rubbed into the hair to kill vermin (*7*).

GENETICS

East African mahogany is closely related to *Khaya grandifoliola*, with which it shares much of the east African range. Another species, *K. grandiflora*, is distinguished by its predominately 5-merous flowers and larger capsules with much thicker valves (*22*). East African mahogany is known to be insect pollinated (*17*). It is assumed that considerable genetic diversity exists across the wide geographic range of *K. nyasica*. A breeding program has begun in Malawi (*19*).

LITERATURE CITED

1. Anonymous. 1959. *Khaya senegalensis* Juss., *Khaya grandiflora C. DC*: Caracteres sylvicoles et plantations. Bois et Forets des Tropiques. 68: 15-20.
2. Boado, I.; Leontovye, R. 1981. Indentificacion de microorganismos que producen las agallas y la gomosis en *Khaya nyasica*. Revista Forestal Baracoa. 11(2): 35-46.
3. Bolza, E.; Keating, W.G. 1972. African timber: The properties, uses and characteristics of 700 species. Melborne, Australia: Division of Building Research, Commonwealth Scientific and Industrial Research Organization. 721 p.
4. Bryce, J.M. 1967. The commercial timber of Tanzania. Moshi, Tanazania: Tanzania Forest Division. 139 p.
5. Bussche, G.H. von dem 1982. The establishment of hardwood plantations for the production of furniture and joinery timber in the Transvaal. Part I: Planting and progress. South African Forestry Journal. 121:11-16.
6. Bussche, G.H. von dem 1982. The establishment of hardwood plantations for the production of furniture and joinery timber in the Transvaal. Part II: Silviculture. South African Forestry Journal. 121: 17-23.
7. Coates Palgrave, O.H.; Coates Palgrave, K.; Coates Palgrave, D.; Coates Palgrave, P. 1957. Trees of Central Africa. Rhodesia and Nyasaland: National Publication Trust. 466 p.
8. Fanshawe, D.B. 1969. The vegetation of Zambia. Kitwe, Zambia: Forestry Research Bullentin No. 7. Ministry of Rural Development. 67 p.
9. Geary, T.F.; Briscoe, C.B. 1972. Tree species for plantations in granitic uplands in Puerto Rico. Res. Pap. ITF-14. Rio Piedras, PR: USDA Forest Service, Institute of Tropical Forestry. 8 p.
10. Hack, R.B. 1950. Notes on trees of Chiranda Forest, Mount Selinda. Rhodesia Agricultural Journal. 47(5): 398-404.
11. Halle, F.; Oldeman, R.A.A.; Tomlinson, P.B. 1978. Tropical trees and forests: An architectural analysis. New York, NY: Springer Verlag. 441 p.
12. Hursh, C.R. 1959. Composition of the tropical dry forests of Nyasaland. p. 49-53 *In* Organization For African Unity. Open Forests. Niamey, Nigeria: Commission for Technical Cooperation in Africa.
13. Korzoun, V.I.; Sokdov, A.A.; Budyko, M.I.; Voskresensky, K.P.; Kalinin, G.P.; Konoplyantsev, A.A.; Korotkevich, E.S.; Luovich, M.I. 1977. Atlas of world water balance. Paris, France: UNESCO Press.
14. Lequarre, A. 1978. La vegetation et l'action Geomorphologique des rivieres dans une region tropicale humida. Geo-Eco-Trop. 1: 103-112.
15. Pardy, A.A. 1953. Notes on indigenous trees and shrubs of S. Rhodesia. Rhodesia Agricultural Journal. 5(2): 153.
16. Streets, R. J. 1962. Exotic forest trees in the British Commonwealth. Oxford, England: Clarendon Press. 750 p.
17. Styles, B.T.; Khosla, P.K. 1976. Cytology and reproductive biology of *Meliaceae*. pp. 61-67 *In* Burley, J.; Styles, B.T. Eds. Tropical Trees: Variation, breeding and conservation. Linnean Society Symposium Series No. 2. London, England: Academic Press. 243 p.
18. Tanganyika Forest Department. 1961. The weights and shrinkage of some local timbers. Technical Notes No. 25. Moshi, Tanganyika: Tanganyika Forest Department. 5 p.

19. Toda, R. 1974. Forest tree breeding in the world. Tokyo, Japan: Meguro. 205 p.
20. Utilization Section. 1961. Timbers of Tanganyika: *Khaya nyasica* (African mahogany; mkangazi). Moshi, Tanganyika: Utilization Section, Forest Department. 5 p.
21. Walter, H.; Harnickell, E.; Mueller-Dombois, D. 1975. Climate diagram maps of the individual continents and the ecological climatic regions of the earth. New York, NY: Springer Verlag.
22. White, F. 1962. Forest flora of Northern Rhodesia. London, England: Oxford University Press. 455 p.